NIOSH RESEARCH ON GENERATOR EXHAUST CONFIGURATIONS AND CARBON MONOXIDE ON HOUSEBOATS

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PROGRESSION OF CONTROL RESEARCH

- Existing Designs
  - Rear exhaust under swim platform (document current design problems)
  - Side exhaust
- New Exhaust Designs
  - Dry Stack exhaust (various heights)

METHODS/EQUIPMENT

- Toxi Ultra CO sensors
- Wind monitoring
- Hot wire anemometer
- Exhaust gas analyzer
- Evacuated containers
- Detector tubes

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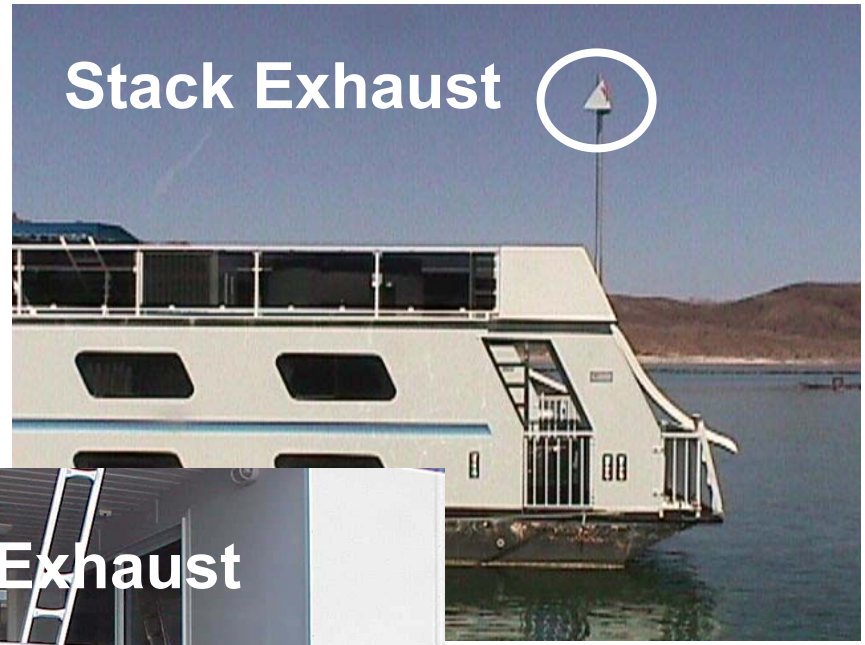
GENERATOR EXHAUST CONFIGURATIONS



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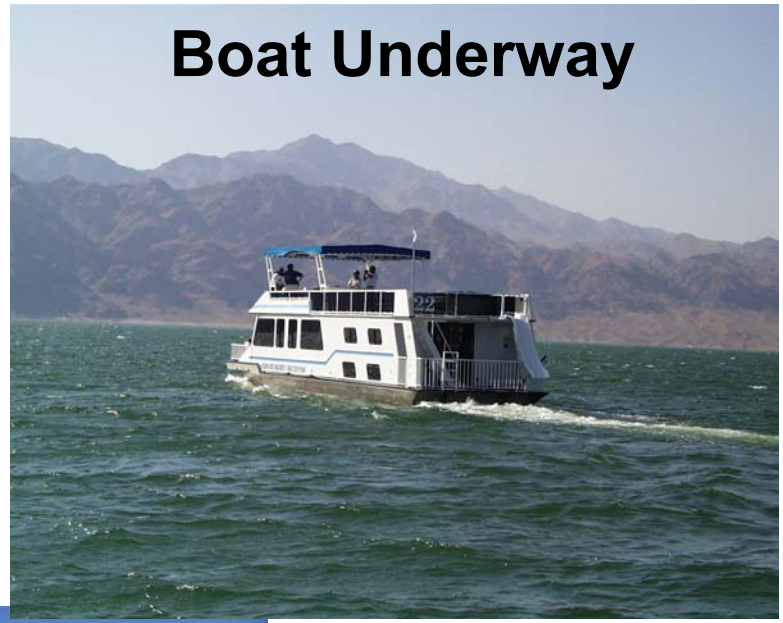
Test Conditions

Boat Stationary

Boat Underway



Boats Tied Together

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STACK HEIGHT EFFECTS

Short Stack

Versus

Tall Stack

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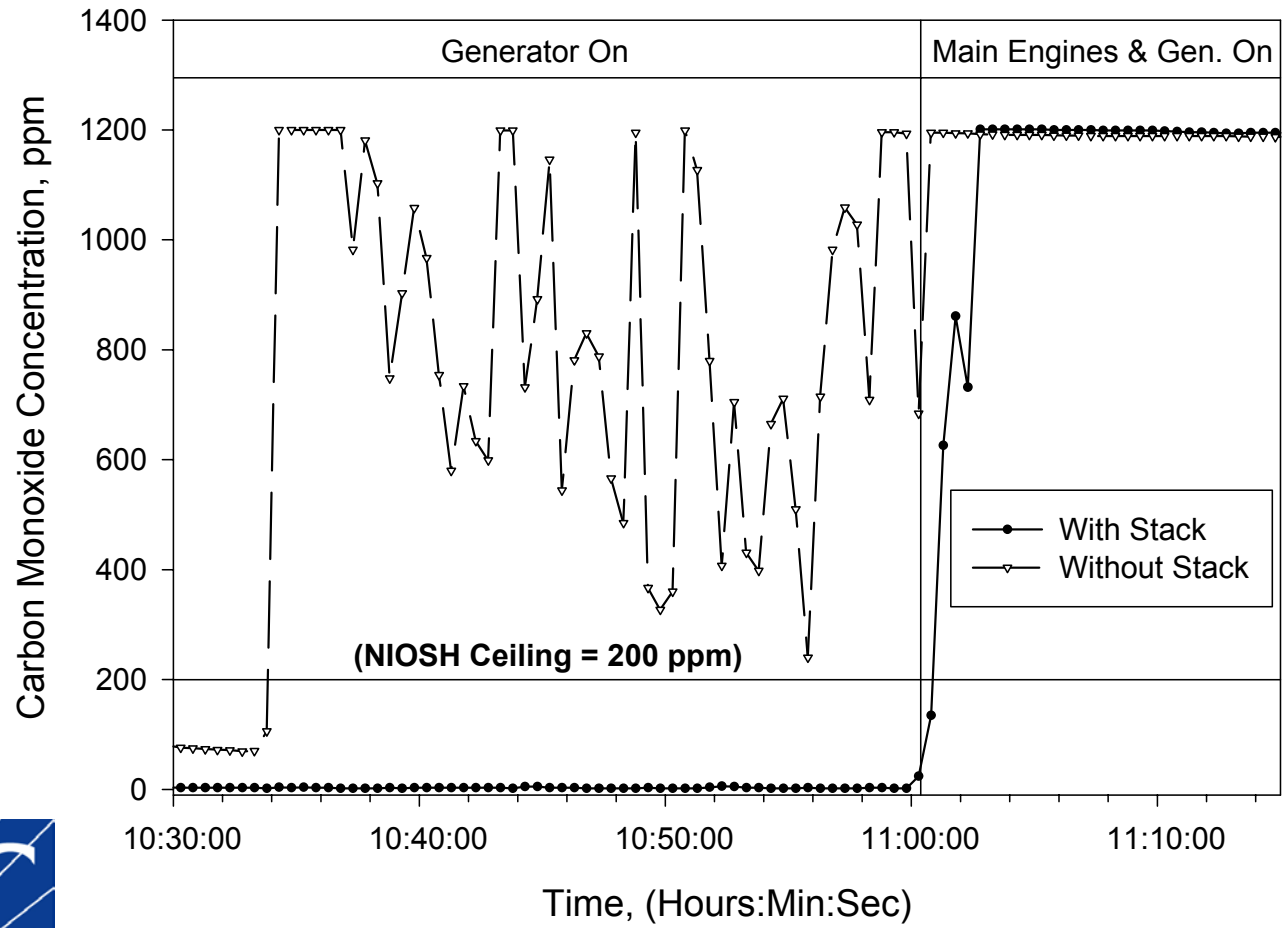
COMPARISON OF STACK VS. REAR EXHAUST

(Sampled on center of swim platform)



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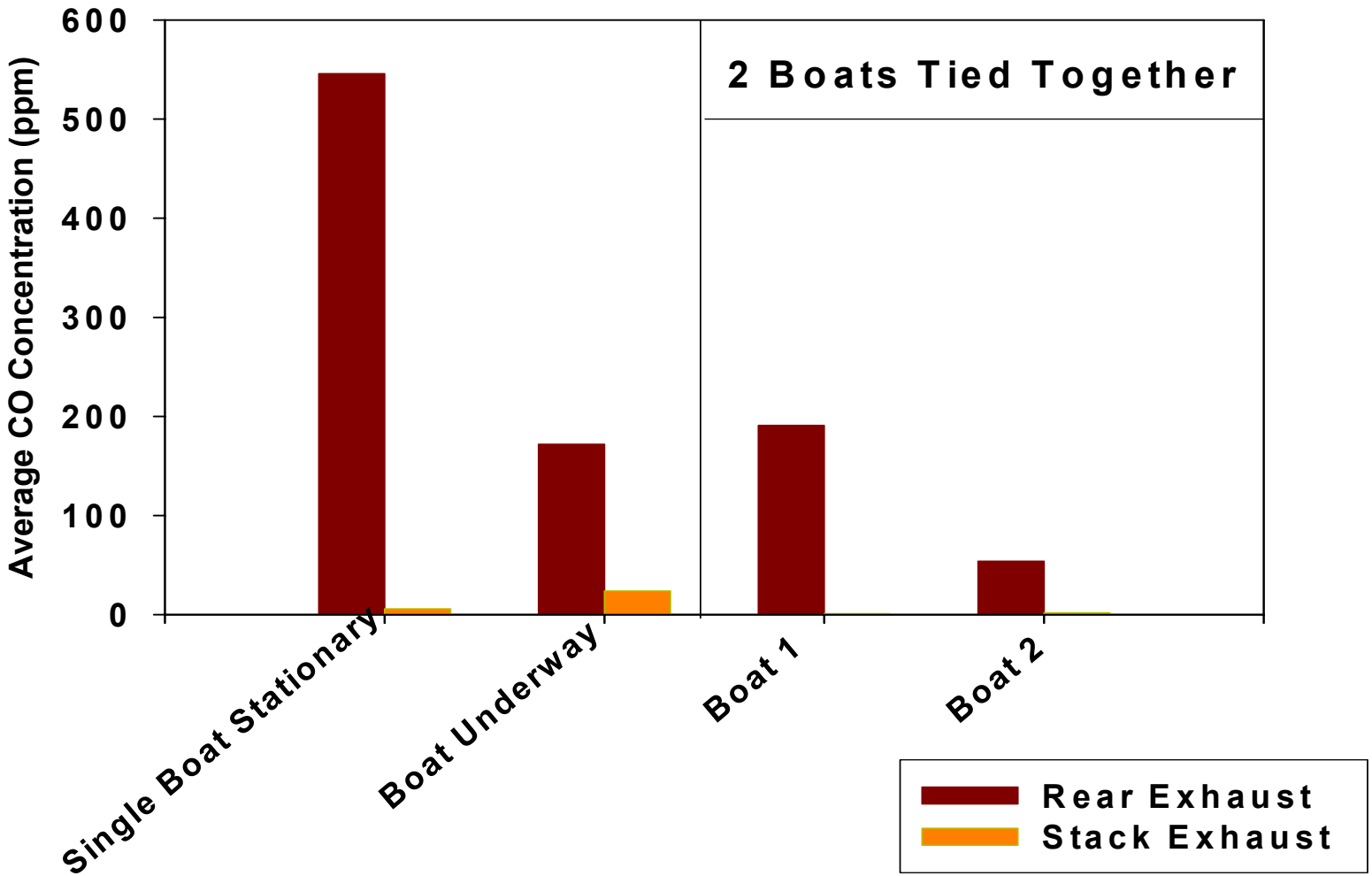
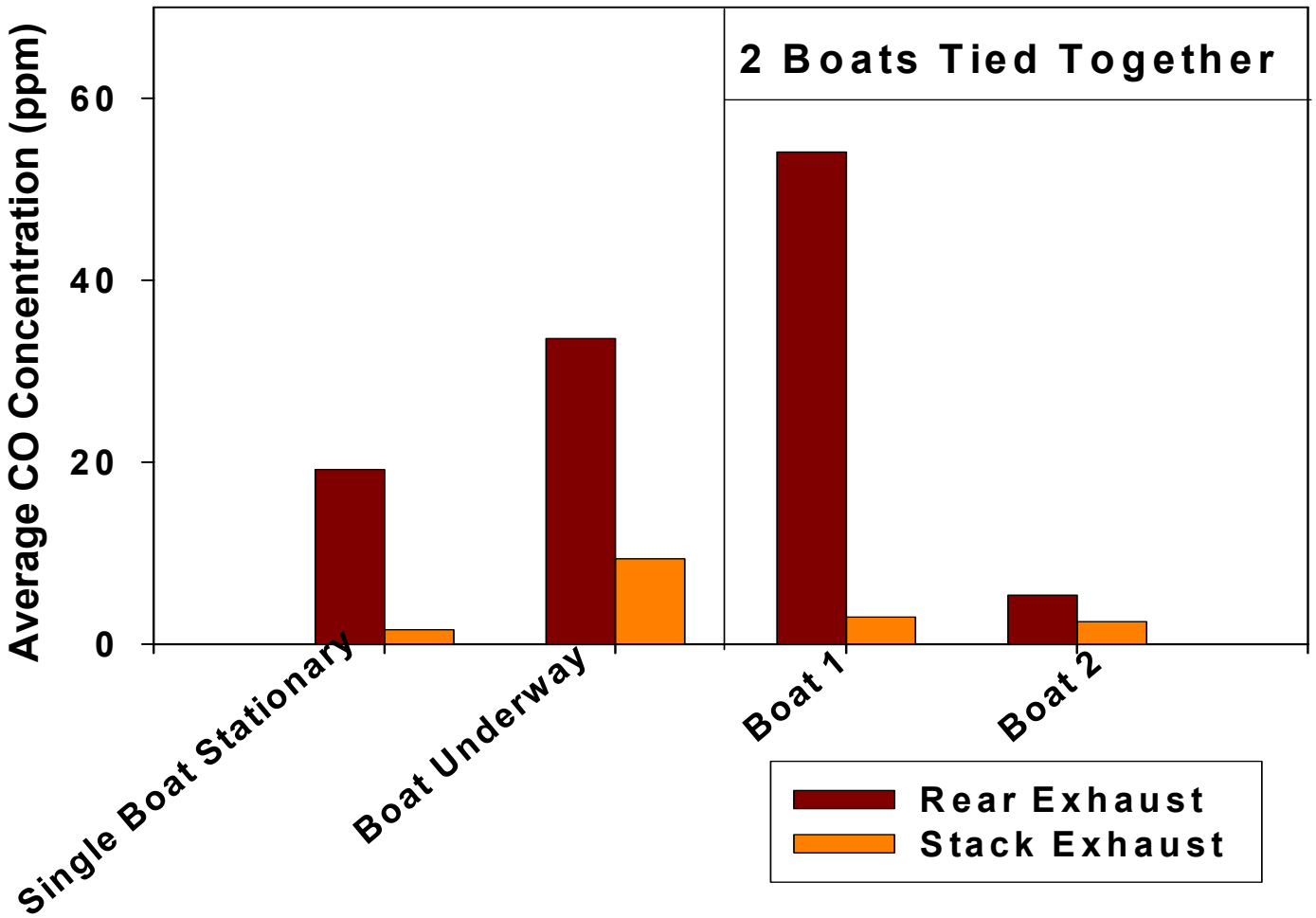
Comparison of Average CO Concentrations
Rear Exhaust vs. Stack Exhaust
Swim Deck



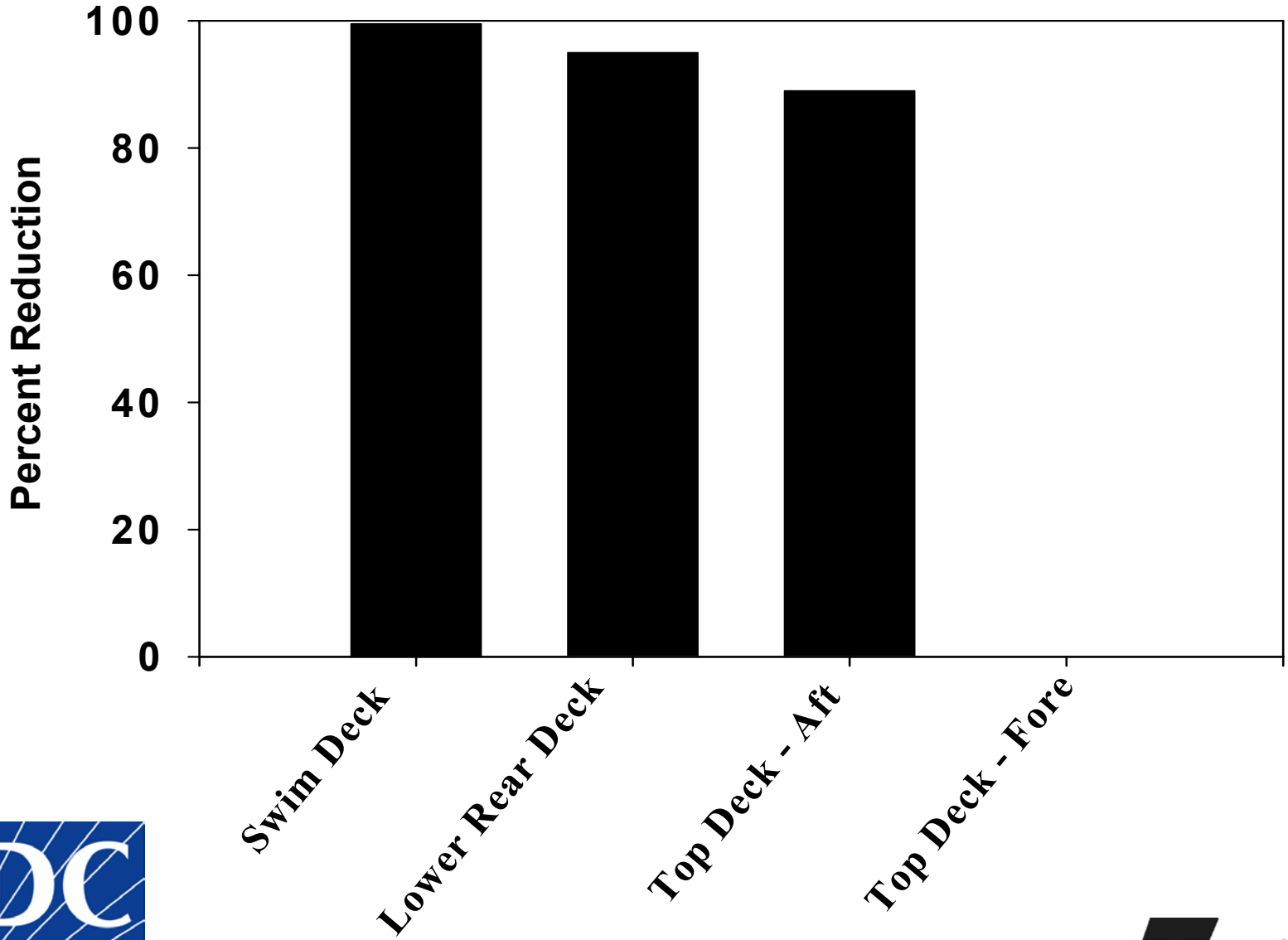
Comparison of Average CO Concentrations Rear Exhaust vs. Stack Exhaust Upper Deck-Stern



CO Concentration Reduction--Stack Versus Rear

Based on Statistical Model of Lake Powell and Mead Surveys

Generator Operating Only



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Side Exhaust - Swim Platform
CO Concentrations (ppm)

Survey Loc	Test Condition	Average	**Peak**
Lake Powell	2 Boats Tied Together	Boat 1: 68 Boat 2: 136	**683** **1033**
Lake Cumberland	Single Boat	78	**503**
Lake Mead	Single Boat	55	**761**
Lake Mead	Single Boat	2	**12**

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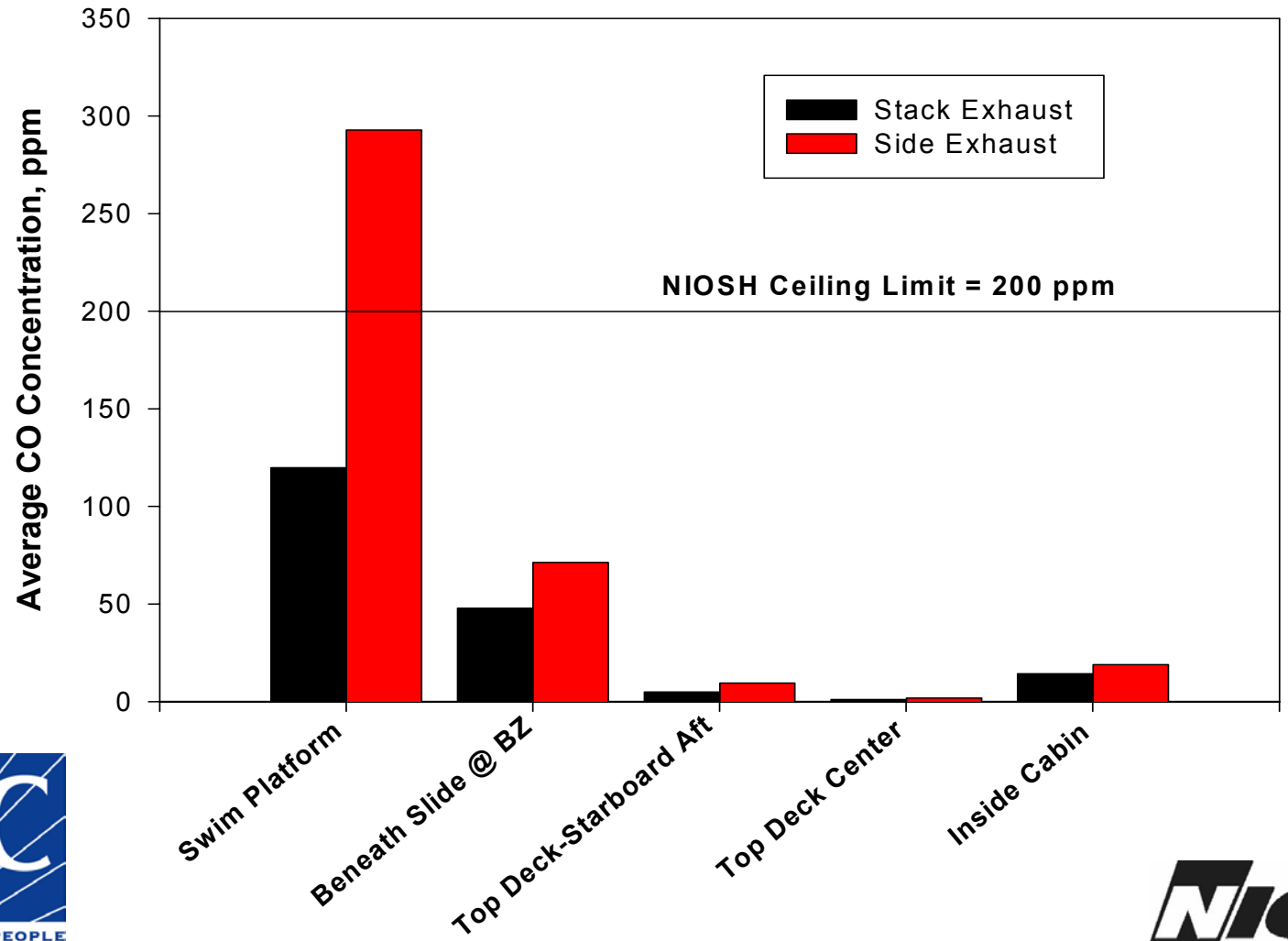
STACK VERSUS SIDE EXHAUST

(Boat underway, Gen. & Drive engines operating)



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SUMMARY OF RESULTS- HOUSEBOATS

- Rear and side exhaust are *potentially* hazardous for stationary houseboats
- Vertical stack - simple and effective control that has performed well during **all evaluations**
- Ambient Temperature/Density Effects
  - Stack evaluated under mild and hot ambient temps (45 F and 118F)
  - No high concentrations measured under any test conditions (peak for all surveys 57 ppm-upper deck and 87 on swim deck)

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Challenges

- Wider implementation of stack
  - Retrofit and new production
- Improperly designed and tested system
- Development of design specifications
  - Stack height/design
    - CO concentration of 479 ppm was measured on top deck when using a short stack
  - Exhaust velocity